



# MODERN GEOCHEMISTRY CLEAN LABORATORIES

## CHALLENGES AND SOLUTIONS

Geochemical research has fundamentally shaped our understanding of the natural world, ranging from the formation of the Solar System, to the inner workings of the Earth and modern environmental processes. These advancements are often based on measurements of small variations in trace element abundan-

ces or isotopic compositions, utilizing sensitive analytical methods and instruments that demand special lab facilities. Here we talk with MK METALFREE employee Dr. Gerrit Budde, who has a background in isotope cosmochemistry and over 15 years of clean lab experience, about the respective requirements, challenges, and solutions.

*What makes geochemistry clean labs such unique environments?*

In modern geochemical research and analyses multiple critical requirements come together:

- (i) precious samples need to be protected from contaminants (e.g., airborne particles of dust or corroded metal) that would compromise their chemical and isotopic compositions,
- (ii) personnel need to be protected against hazardous substances (primarily acid fumes) used for sample digestion/processing, and
- (iii) the laboratory needs to be corrosion-protected and chemically resistant, provide stable ambient conditions, and minimize the inherently high energy demand.

This can only be achieved through the combination of a low-particulate environment, a sophisticated air handling concept (i.e., conditioning, filtration, circulation), state-of-the-art equipment (incl. hoods), and all components being metal-free.

*Why are these metal-free clean labs so challenging to build?*

A particular challenge relates to the air handling: these laboratories typically require narrow temperature and humidity ranges (despite variable/extreme outside conditions), a very high frequency of air changes in the individual rooms and hoods, and a complex room pressure cascade. This is further complicated by the inherent constraints of a metal-free construction and the fact that existing buildings often provide limited space or outdated infrastructure that was not designed to support such a demanding facility. Satisfying those high cleanliness, safety, and air handling requirements under such unfavorable circumstances needs a holistic approach, ideally from a single provider with extensive expertise in all aspects of planning and implementation. This has proven to be crucial for successfully completing such delicate projects, while minimizing construction times and costs as well as maximizing energy efficiency, durability, and sustainability.



*Fig. 1. MK Workstation with vertical laminar flow of HEPA-filtered air (typically Class 3, ISO 14644) as well as integrated volume flow controllers and PLC (programmable logic controller) unit. Also available as MK Combination Station with separate chamber for isolated evaporation/hot-plate usage. Retrofitting to existing clean labs as stand-alone version possible.*



explains:

**METALFREE CLEANROOMS**



[https://www.youtube.com/watch?v=ygX2RsNv\\_90](https://www.youtube.com/watch?v=ygX2RsNv_90)



and come with a PLC unit for the dynamic adjustment of airflows, direct control of integrated equipment (e.g., hotplates, acid stills), as well as remote monitoring and servicing options (Fig. 1).

*Are there alternatives to the traditional metal-free clean labs?*

In response to space, old building infrastructure, time, and funding becoming increasingly limiting and complicating factors, MK has started containerizing complete metal-free clean labs as flexible turnkey solution (Fig. 2). These MK Mobile Labs can be a single container or a (multi-story) container complex, and operate largely as self-sustained systems (incl. HVAC system with HEPA filtration). They can be designed and built within a relatively short time frame, completely assembled and tested in the factory, shipped anywhere in the world, and then rapidly installed in almost any open space. As such, MK Mobile Labs present a cost-effective alternative with all the benefits of a building-integrated (room-in-room) clean lab and additional advantages; for instance, they are highly customizable and modifiable through their modular design, and can serve as permanent installation or as interim solution that can change locations.

*What sets MK METALFREE apart from other companies?*

Germany-based MK Versuchsanlagen and its US subsidiary MK METALFREE have over 30 years of experience in planning and building cutting-edge metal-free clean labs and equipment. By providing all key components and services in-house (design, software, manufacturing, installation, etc.), MK is able to not only master the challenges of modern geochemistry clean labs, but also to offer solutions tailored to the particular needs of each customer. Their unique portfolio includes everything from hotplates and lab furniture to complete turnkey clean labs (incl. air handling), which stand out with state-of-the-art components and manufacturing, a smart control/monitoring system, highest cleanliness and safety standards, as well as an exceptional ener-

*What is so special about the MK Workstations?* The metal-free MK Workstations are fundamentally different from conventional fume hoods, in that a vertical laminar flow of HEPA/ULPA-filtered air, and its extraction through a perforated work surface, ensures the operator's safety by preventing acid fumes from escaping, while simultaneously providing ultra-low particulate and corrosion-protected conditions for contamination-free sample processing. They further stand out with an optimized airflow design as well as integrated supply and exhaust air volume flow controllers, resulting in an air demand that is less than half that of comparable total exhaust laminar flow hoods. MK Workstations offer many customization options due to their modular design

*Fig. 2 Interior (left) and exterior (right) views of MK Mobile Lab installed on the roof of the Max Planck Institute for Solar System Research in Göttingen, Germany. It consists of six containers and includes HVAC system, gowning room, storage/preparation room, weighing room, and Class <6 (ISO 14644) cleanroom with ten MK Workstations / Combination Stations.*



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gy efficiency resulting from the low air demand (due to MK Workstations and partial room air recirculation). Dozens of successful metal-free clean lab constructions across the world are testament to the company's expertise, making MK a trusted partner in the scientific community.



Contact USA: Dr. Gerrit Budde  
MK METALFREE CORP.  
13370 W Foxfire Drive, Ste 103  
Surprise, AZ 85378 (Phoenix Office)  
sales@mk-metalfree.com  
www.mk-metalfree.com

Contact Europe: Dr. Wolfgang Küstner  
MK Versuchsanlagen GmbH & Co. KG  
Stückweg 10  
35325 Mücke, Germany  
sales@mk-versuchsanlagen.de  
www.mk-versuchsanlagen.de



Mobile Lab

The mobile and metal-free sample preparation of MK Versuchsanlagen



<https://www.youtube.com/watch?v=mqPIEcZl4XA>